

January 11, 2015

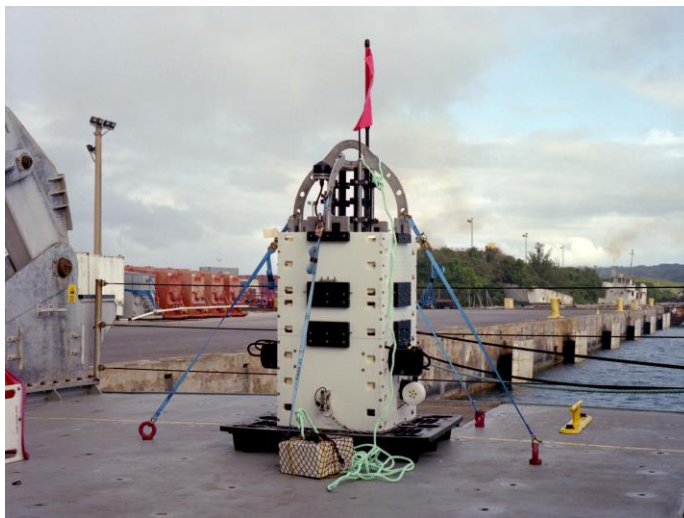
## FK141215 post cruise report

This cruise took place December 15-21, 2014 in the Challenger Deep within the territorial waters of the Federated States of Micronesia, and in the Sirena Deep portion of the US Mariana Trench Marine National Monument using the R/V Falkor, operated by the Schmidt Ocean Institute. Four different untethered instruments (one with two different payloads) were deployed deep into the trench a total of seven times.

### 1. Dec. 16 – Leggo drop 1 with PRS payload

Lander description: This lander primarily relies on syntactic foam for buoyancy and uses iridium GPS, radio signal, strobe light and flag for surface recovery, and acoustics for underwater monitoring and instrument control. The lander also has a timer with 5 control settings for various operations. It routinely measures pressure (depth) throughout its dive and temperature on the seafloor. The lander payloads include a pressure-retaining seawater sampler plus 2 liter Niskin bottle, and a camera/battery/light system that also includes a 30 liter Niskin bottle and a sea cucumber trap. With the camera payload it travels down or up the water column at about 39 meters per minute (~ 4 ½ hours for a descent to the Challenger Deep at ~10,920 m). Bartlett and colleagues use this lander to collect seawater with and without decompression, and to film and collect scavenging animals, from the deepest depths of the Mariana Trench.

Lander image:



Time (in Guam) deployed/recovered: 9:00/19:26

Position at deployment: 11° 21.9836 N 142° 25.9533 E, middle section of the Challenger Deep.

Greatest depth of dive: approximately 10,900 m (pressure sensor not turned on).

*In situ* temperature on seafloor: 2.6°C.

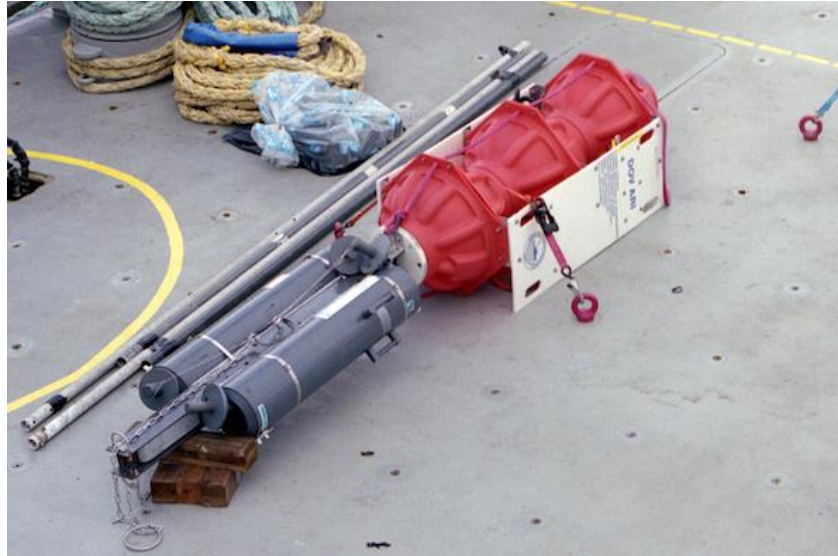
Notes: PRS was at a pressure of about 13,000 pounds per square inch (90 megapascals, ~81% of the expected *in situ* pressure). The temperature in the small 2 liter Niskin bottle was 15.4°C

upon retrieval. The seawater collected is being used to examine the effects of decompression on the abundance, diversity and activity of the microbes present in this deep trench environment.

## 2. Dec. 16 ARI drop 1

Lander description: This lander was an older design that made use of three Vitrovex glass floats for buoyancy. It contained two 30 liter Niskin bottles attached to a fiberglass frame. It also contained iridium GPS, radio signal, strobe light and flag for surface recovery, and acoustics for underwater monitoring and instrument control. The lander also had a timer. Chicken bait was attached to the inside of the Niskin bottles so that they could be used to trap scavenging animals.

Lander image:



Time (in Guam) deployed: 16:14

Position at deployment: 11° 21.5809 N 142° 27.2969 E, middle section of the Challenger Deep

Notes: ARI not recovered. The reason for the instrument failure is unknown.

3. Dec. 16 Deep Sound 3 drop 1

Lander description: The Deep Sound landers measure ambient noise from the deepest ocean depths. They continuously monitor the ambient noise, temperature, salinity, pressure, and system orientation throughout the round trip from the surface to the bottom. In particular, several hydrophones return ambient noise time series, each with a bandwidth of 30 kHz. Among other things they can be used to listen in on deep trench life and seismic activity. Very little data exists on sound at great ocean depths, but could be important as sound speed within the trench will increase as a result of the high pressure.

Lander image:

Deep Sound, Mark II



Deep Sound, Mark III



Time (in Guam) deployed/: 20:55

Position at deployment: , middle section of the Challenger Deep

Notes: Deep Sound 3 not recovered. The reason for the instrument failure was due to a catastrophic implosion of either a ceramic or Vitrovex glass sphere.

4. Dec. 16/17 Deep Sound 2 drop 1

Lander description: see number 3 above.

Lander image: see number 3 above.

Time (in Guam) deployed/recovered: 21:19/6:16

Position at deployment: 11° 21.5999 N 142° 27.2484E, middle section of the Challenger Deep

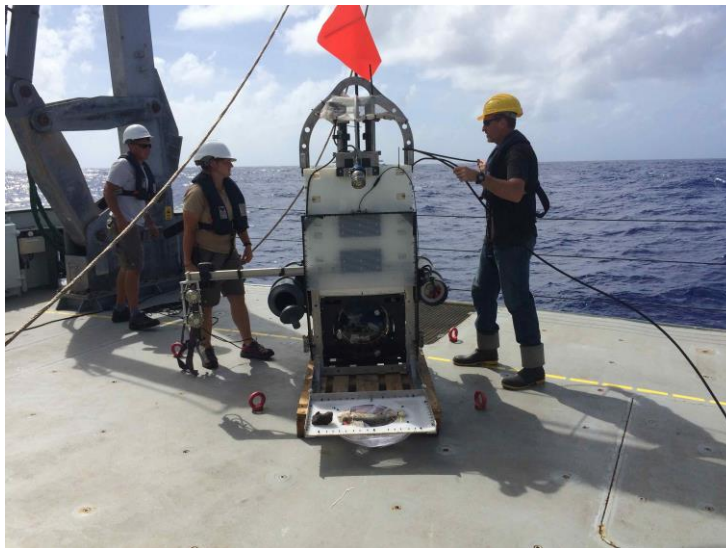
Greatest depth of dive: 9,000 m.

Notes: The Deep Sound 2 recorded the implosion/explosion of Deep Sound 3 when the deep Sound 3 was at a depth of 8,620 m. Although the loss of the Deep Sound 3 instrument was unfortunate, the noise of its explosion provided a sound source for characterization of the Challenger Deep by the Deep Sound 2.

5. Dec. 17/18 Leggo drop 2, with Camera payload

Lander description: see number 1 above.

Lander image:



Time (in Guam) deployed/recovered: 13:42/7:18

Position at deployment: 11° 21.5745N 142° 27.3681E, middle section of the Challenger Deep

Greatest depth of dive: 11,010 m (uncorrected depth)

*In situ* temperature: 2.3°C

Notes: seawater temperature in the 30 liter Niskin bottle after recovery was 8.6°C. Some seawater was saved in a bottle placed in the cold van. No seawater was processed, no amphipods were collected. The video showed some out of focus amphipods.

6. December 18/19 Leggo drop 3, with Camera payload

Lander description: see number 1 above. Also note that filming was coordinated as follows:

1. still photo at focus set to 10'
2. still photo at focus set to 7'
3. still photo at focus set to 3' (very sharp images obtained)
4. 30 second video at 10'
5. 30 second video at 7'
6. 30 second video at 3' (very sharp images obtained)
7. lights and camera off for six minutes.
8. lights and camera on, repeat cycle.

Lander image: see number 5 above.

Time (in Guam) deployed/recovered 13:14/10:14

Position at deployment 11° 22.1122 N 142° 35.2510 E, eastern section of the Challenger Deep

Greatest depth of dive: 11,168 m (uncorrected)

*In situ* temperature: pending

Notes: temperature of Niskin water measured back on ship: 10.8°C. Twenty three amphipods collected, divided among the Bartlett and Qian groups.

7. December 18/19 Deep Sound 2

Lander description: see number 3 above.

Lander image: see number 3 above.

Time (in Guam) deployed/recovered 19:55/05:10

Position at deployment 11° 22.1302 N 142° 35.1755 E, eastern section of the Challenger Deep

Greatest depth of dive: 9,000 m

Notes: once again Deep Sound 2 worked well.

After arriving on site, first over the middle section of the Challenger Deep, we began a series of five lander deployments. The Leggo lander, with a pressure-retaining water sampler payload, was first deployed, followed by the ARI lander used for attracting scavenging animals, followed by two instruments used to measure ambient noise the ocean, Deep Sound 3 and then Deep Sound 2, and then the Leggo lander was used again, this time with its camera payload system. The Leggo lander worked extremely well and recovered valuable trench bottom seawater maintained near to its original *in situ* pressure. Unfortunately, the ARI lander was lost at sea. The reason communication with this instrument was lost is unknown but it is likely to have been the result of a catastrophic implosion and subsequent shock wave of either the pressure housing employed (although it was used two years ago in the Challenger Deep) or of one of the Vitrovex spheres. Also unfortunate, was the loss of the Deep Sound 3 lander. In this case the reason for its loss is known, as its sound properties were recorded in detail from the Deep Sound 2 lander that was successfully deployed at a nearby location to a depth of about 9,000 m and then recovered. Data from Deep Sound 2 recorded the loss of Deep Sound 3 when the latter was at a depth of 8,620 m. The unexpected addition of a sound source deep within the Challenger Deep provided the unanticipated benefit of improved acoustic characterization of this trench environment. The final lander deployment/recovery at the first drop location was the Leggo Lander (drop 2) with its pressure-retaining water sampler payload replaced with its camera/lights/battery payload that also included a mackerel-baited 30 liter Niskin bottle and a similarly baited sea cucumber trap immediately in front of the camera. During the drop the Leggo lander was kept off the seafloor by about one meter. This deployment was also successful, although the camera needed refocusing and no animals were collected. The photos and images revealed some scavenging amphipods coming to the fish bait.

After the second recovery of the Leggo lander the expedition moved 17 miles east to the eastern section of the Challenger Deep, the site of other past expeditions, including the 2012 James Cameron Deepsea Challenge expedition, and earlier deployments by the Nereus and Kaiko remote operated vehicles/autonomous underwater vehicles. The Leggo lander was used for its last drop at this location, in this case with the lander sitting directly on the seafloor. This dive was highly successful. The photos and videos recovered were well focused revealing in stunning detail many dozens, perhaps hundreds of amphipod crustaceans feeding on the bait, up to about 5 cm in length. Twenty three amphipods were recovered. These are being used for a range of studies, including 1) taxonomy and phylogenetics, 2) genomics, 3) proteomics and transcriptomics (for better id of proteins), 4) microbial population studies, and 5) microbial metagenomics associated with the animals. The ultimate goal will be to understand the biological adaptations of animals and microbes to extreme environment.



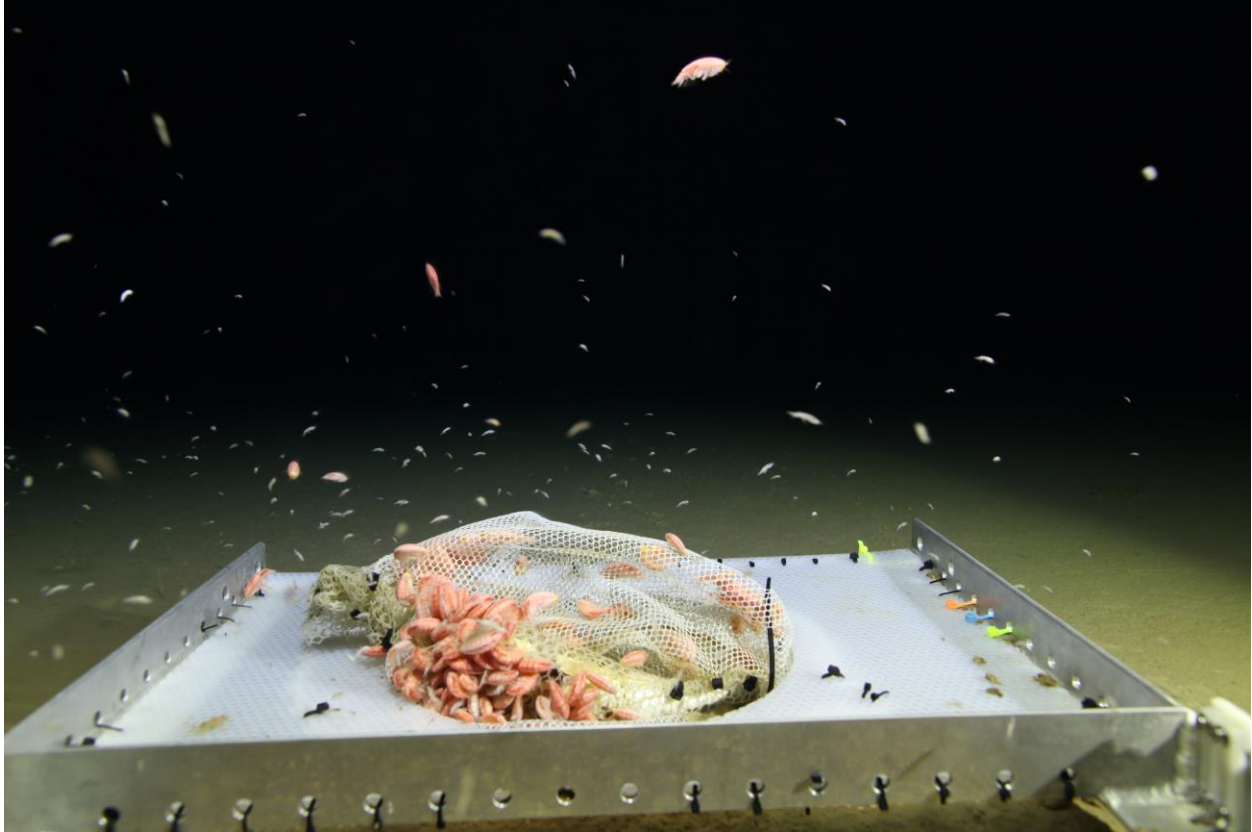


Image obtained from the Leggo lander in the eastern portion of the Challenger Deep. Many amphipods on and near the fish bait can be seen, as well as some of the surrounding seafloor environment.

Deep Sound 2 was also deployed, for its second time, again to a depth of 9,000 m. It also worked well and its sound and additional physical data has been downloaded. During Deep Sound's profiling of the water column, the instrument recorded the pressure time series on four hydrophones, configured in an 'L' shaped array for the first deployment, and in a vertical array for the second. Conductivity, temperature and depth were recorded in order to estimate the sound speed profile. Depth profiles of the power spectral density and spatial coherence will be computed in order to characterize the noise directionality and identify the various contributions to the ambient noise field, including geophony, biophony and anthropogenic noise.

Originally it was planned that additional work would be performed. The CTD rosette winch was broken and so its use was prevented. In addition, the crew of the Falkor was not comfortable deploying their lander, which had been rigged up for collecting seafloor rocks and sediment using Van Veen grabs. The last location for sampling was intended to the Sirena Deep, located within the U.S. Mariana Trench Marine National Monument. However, ~ 3 m waves made deploying/recovering landers difficult and so these operations were cancelled. On December 19 we left the territorial waters of Micronesia. We were back at the dock in Apra Harbor, Guam on the morning of December 21.

Cruise track:

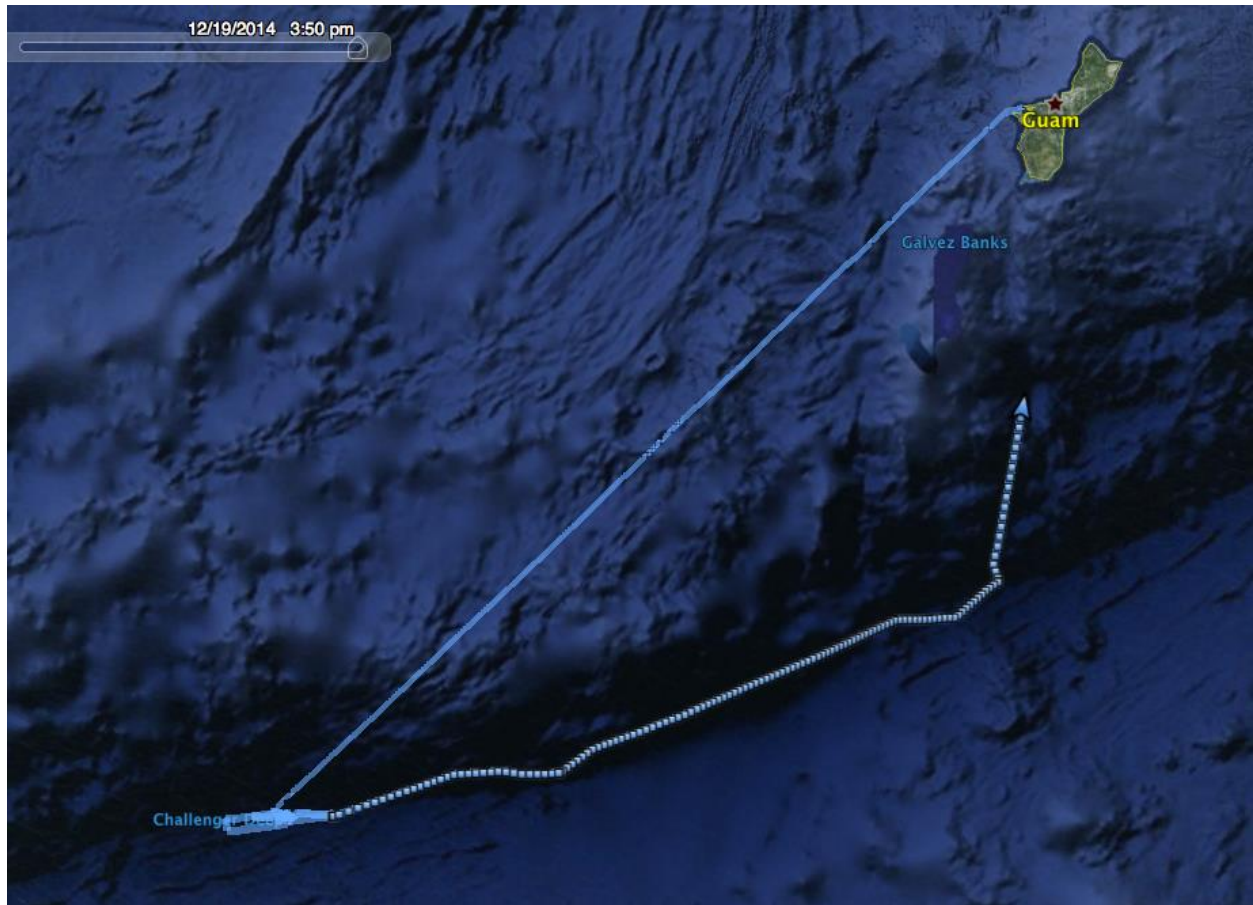


Table 1: Data obtained during cruise

NO	units	Description
36	km	CTD data from two sets of Deep Sound 2 descents/ascents in Challenger Deep (CD)
18	Hours	Hydrophone data from Deep Sound 2 lander in CD
43.6	km	Depth data from two sets of Leggo lander descents/ascents in CD
10	measurements	Leggo temperature data near CD bottom
19.5	hours	Lander bottom time during which filming in CD occurred.
250	milliliters	Seawater collected from CD
Twenty three	specimens	Total number of amphipods collected from CD
2	tubes	Total organic measurements in CD
2	tubes	General nutrients in CD
4	cryovials	Frozen samples for cell and virus counts in CD
9	cryovials	Cryovials for single cell genomics from CD
8	Petri plates	Samples plated out for microbe viable counts- CD
8	bulbs	Viable counts at low/high pressure from CD
2	bulbs	Seawater preserved at high pressure from CD
2	amphipods	Stored in RNALater for molecular biology
2	amphipods	Frozen at -80°C for molecular biology
2	amphipods	Preserved in paraformaldehyde for microscopy
1	amphipod	Homogenate incubated at high pressure

Table 2. Lander Deployments during this cruise

Latitude	Longitude	Description
11° 21.9836 N	142° 25.9533 E	Leggo lander deployment in middle part of Challenger Deep. Seawater samples obtained +/- decompression.
11° 21.5809 N	142° 27.2969 E	ARI lander deployment in middle part of Challenger Deep. Lost at sea.
11° 21.5999 N	142° 27.2484E	Deep Sound 3 lander deployment in middle part of Challenger Deep. Lost due to catastrophic implosion at 8620 m.
11° 21.5999 N	142° 27.2484E	Deep Sound 2 lander deployment in middle part of Challenger Deep. Recorded ambient noise down to 9,000 m.
11° 21.5745N	142° 27.3681E	Leggo lander deployment in middle part of Challenger Deep. Scavenging amphipods filmed 1 m off seafloor.
11° 22.1122 N	142° 35.2510 E	Leggo lander deployment in eastern part of Challenger Deep. Scavenging amphipods filmed on seafloor. Animals also collected.
11° 22.1302 N	142° 35.1755 E	Deep Sound 2 lander deployment in eastern part of Challenger Deep. Recorded ambient noise down to 9,000 m.



A handwritten signature in black ink, appearing to read 'Doug Bartlett', with a stylized flourish at the end.

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